COURSE TITLE	**CHEMICAL REACTION ENGINEERING-I**
COURSE CODE	**01CH0508**
COURSE CREDITS	**4**

Objective:

1 This course explains the kinetics of chemical reaction, reactor design, integral method of analysis, differential method of analysis, principles of chemical reactor analysis and design.

Course Outcomes: After completion of this course, student will be able to:

1 Build basic knowledge and understanding of classification of reactions.

2 Understand the fundamentals and kinetics of chemical reaction.

3 Design of reactor for single and multiple reactions in homogeneous condition.

4 Analyze the performance of non-ideal reactors using, tanks-in series model, dispersion model and segregation model.

5 Evaluate the size and performance calculations on isothermal plug, mixed, and batch reactors.

Pre-requisite of course: Basic knowledge of material and energy balances in chemical engineering applications, laws of thermodynamics.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction to Reaction Engineering** Classification of reactions, definitions of reactions rate,, variables affecting reaction rate, Simple reactor types,, types, concentration dependent term of rate equation. Molecularity and order of reaction,, Elementary and non-elementary reaction,, Introduction to Arrhenius, collision and transition state theory.	8
2	**Chemical Kinetics** Constant volume batch reactor, analysis of total pressure data,, analysis of total pressure data,, Integral and differential methods of analysis of data for constant volume and variable volume cases.	6
3	**Design of Ideal Reactor** Mass and energy balances around a volume element. Ideal batch reactor,, steady- state mixed flow reactor, steady-state plug-flow reactor,, holding and space timefor flow reactors, Size comparison of single reactors, multiple reactor systems,, recycle reactor and autocatalytic reactions.	8

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Contents : Unit	Topics	Contact Hours
4	**Design for multiple reactions** Introduction to multiple reactions, Parallel reactions of different orders,, Yield and selectivity, Product distribution and design for single and multiple-reactors., Irreversible first order reactions in series,, Quantitative treatment, for plug flow or batch reactor and mixed flow reactor, their performance characteristics.	8
5	**Temperature and pressure effects** Single Reactions: Calculations of heats of reaction and equilibrium constants from thermodynamics,, equilibrium conversion, general graphical design procedure., Design of non-isothermal reactors,, Effect of temperature on product distribution for series and parallel reactions	8
Total Hours		**38**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment 1** To determine the activation energy of the reaction between sodium thio-sulphate and HCl using Arrhenius Equation.	2
2	**Experiment 2** To determine order of reaction for the reaction between sodium thio-sulphate and HCl.	2
3	**Experiment 3** To determine the kinetics of the reaction between ethyl acetate and sodium hydroxide at room temperature by the integral method of analysis.	2
4	**Experiment 4** To measure the kinetics of a reaction between ethyl acetate and sodium hydroxide under condition of excess ethyl acetate at room temperature.	2
5	**Experiment 5** To determine the activation energy and frequency factor for reaction between ethyl acetate and sodium hydroxide at room temperature & at different temperature.	4
6	**Experiment 6** To determine the kinetics of the reaction between ethyl acetate and sodium hydroxide at room temperature by the differential method of analysis.	4
7	**Experiment 7** To determine the kinetics of the reaction between n- butyl acetate and sodium hydroxide at room temperature by the integral method of analysis.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
8	**Experiment 8** To determine the kinetics of the reaction between n- butyl acetate and sodium hydroxide at room temperature by the differential method of analysis.	2
9	**Experiment 9** To determine order of reaction for the reaction between sodium thio-sulphate and HCl using CSTR.	2
10	**Experiment 10** To determine order of reaction for the reaction between sodium thio-sulphate and HCl using PFR.	2
Total Hours		**24**

Textbook :

1 Chemical Reaction Engineering, 3rd Edition, , Octave Levenspiel,, Wiley-India Pvt. Ltd., 2006

2 Chemical Engineering Kinetics, 2nd edition,, J.M. Smith,, McGraw-Hill. New york, 1972

References:

1 The Engineering of Chemical Reactions, , The Engineering of Chemical Reactions, , L. D. Schmidt, Oxford Press., 1998

2 Elements of Chemical Reaction Engineering, 4th Edition, ., Elements of Chemical Reaction Engineering, 4th Edition, ., H. Scott Fogler,, Prentice Hall of India Pvt. Ltd, 2008

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery

Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
20.00	20.00	30.00	20.00	10.00	0.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

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Instructional Method:

4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

1 http://nptel.ac.in

2 https://ocw.mit.edu

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